



Title: Computer graphics

Final exam, Date: 19/6/2011, Total marks: 75

Course code: CCE2211

Allowed time: 3 hours

Year: Second year

Number of pages: 2

## Workout the following questions

### Question 1 (15 marks)

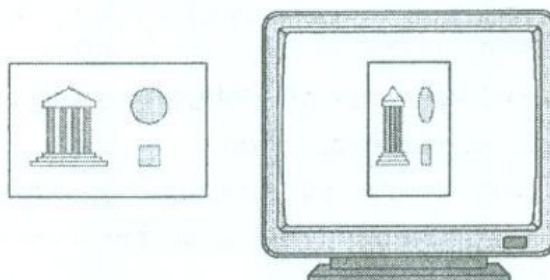
- What is *Computer Graphics* and how it's different from *Image Processing*? (5 marks)
- A graphics programmer or designer works with some interfaces or APIs to produces graphics. Two conceptual models could be used to describe the interaction between the programmer/designer and the interface/API: pen-plotter model and the 3D graphics model. Explain the difference between the two models (5 marks)
- The memory in a frame buffer must be fast enough to allow the display to be refreshed at a rate sufficiently high to avoid flicker. A typical workstation display can have a resolution of 1280 x 1024 pixels. If it is refreshed 72 times per second, how fast must the memory be? That is, how much time can we take to read one pixel from memory? What is this number for a 480 x 640 display that operates at 60 Hz but is interlaced? (5 marks)

### Question 2 (15 marks)

- OpenGL output is strictly specified and will predictable when we model our objects using *simple, convex and flat* polygons. What is a flat polygon? What is a simple polygon? What is a convex polygon? Give example in drawing when possible. (5 marks)
- Write an OpenGL program the draw a sphere centered at the origin with a unit radius. Explain in drawing how you approximate the sphere in primitives that OpenGL can draw. (10 marks)

### Question 3 (15 marks)

- The following figure shows a scene that appears deformed when displayed on the output screen of an OpenGL program
  - Discuss possible reasons that could lead to the shown deformation
  - How you can avoid such deformations?



- Write an OpenGL program to draw a damped sine function four times, each in a separate quarter in the output graphics window. Hint; use the viewport setting to change the location and size of the output graphics area with respect to the output graphics window. (10 marks)

#### Question 4 (15 marks)

What is hierarchical modeling? What are its advantages? (5 marks)

Write an OpenGL program to draw a rectangle of size 3 by 3 units each time the mouse is left-clicked with a color chosen randomly. The program terminates when the user right-click the mouse. Your program should interact correctly even if the user changes the window size. (10 marks)

#### Question 5 (15 marks)

a) In the context of OpenGL programming, explain the following (5 marks)

- i. Picking
- ii. Interactive modeling

b) If you know the following:

The two-dimensional point (in a Cartesian coordinates):  $x = \cos(\theta)$  ,  $y = \sin(\theta)$  lies on a unit circle regardless of the value of  $\theta$ . Also, the three points  $(-\sin(\theta), \cos(\theta))$ ,  $(-\cos(\theta), -\sin(\theta))$ , and  $(\sin(\theta), -\cos(\theta))$  lie on the unit circle. These four points are equidistant along the circumference of the circle. By connecting the four points we get a square that has a side length of  $\sqrt{2}$ . This is true for any value of  $\theta$ .

Write an OpenGL program that draw a rotating square using the above information

**Good Luck**

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**Course Coordinator: Dr. Hamed Hemeda**

**And the examination committee**